

# **Technical Document**

## **2006 Utah Hospital Comparison**

### **Adult Pneumonia Report: Charges, Quality and Patient Safety, 2003- 2005**

#### **A Health Care Consumer's Report for Utahns**

**Office of Health Care Statistics  
Health Data Committee**

# **Utah Department of Health November 2006**

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## **Introduction**

### **Mandates for Publishing Utah Health Care Consumer's Reports:**

Utah Senate Bill 132, titled "Health Care Consumer's Report," passed by the 2005 Utah Legislature, requires the Health Data Committee (HDC) to report health facility performance annually for consumers. The public consumer reports shall use nationally recognized quality and patient safety standards and facility charges for conditions or procedures. In December 2005, the HDC began to publish a series of hospital comparison reports on hospital charges, quality and patient safety.

### **Purpose of the Technical Documentation:**

This technical documentation is one of a series of publications to provide technical information and methodological explanations on the Utah Health Care Consumer's Reports. Audience for this publication includes hospital personnel, health professionals, health data analysts and other interested professionals.

### **The Health Data Committee**

Chapter 33a, Title 26, Utah Code Annotated established the thirteen-member Utah Health Data Committee. In accordance with the act, the committee's purpose is—

*"to direct a statewide effort to collect, analyze, and distribute health care data to facilitate the promotion and accessibility of quality and cost-effective health care and also to facilitate interaction among those with concern for health care issues."*

### **The SB132 Health Care Consumer's Report Task Force**

The Health Data Committee established the SB 132 Health Care Consumer's Report Task Force in 2005. The SB132 Task Force is a technical advisory group that provides consultation to the Utah Health Data Committee and its staff members in the Office of Health Care Statistics on measures, methods, and priorities for developing Health Care Consumer's Reports and related web reporting system.

## **Data Source**

### **The Hospital Discharge Database**

The data source for the Utah health care consumers' reports is the statewide hospital discharge database. Administrative Rule R428-10, titled "Health Data Authority, Hospital Inpatient Reporting Rule," mandates that all Utah licensed hospitals, both general acute care and specialty, report information on inpatient discharges. Since 1992, all hospitals have reported "discharge data" for each inpatient served. "Discharge data" means the consolidation of complete billing, medical, and demographic information describing a patient, the services received and charges billed for each inpatient hospital stay. Discharge data records are submitted to the office quarterly. The data elements are based on discharges occurring in a calendar quarter.

## **Method of Reporting Charges**

### **Use of APR-DRG, "All-patient Refined (APR)-Diagnosis Related Group (DRG)"**

The APR-DRG, "All-patient Refined (APR)-Diagnosis Related Group (DRG)," classification system is used in the Utah healthcare consumer's reports to categorize discharge records into different diseases/conditions groups of patients.

#### **❑ Diagnosis Related Group (DRG)**

The DRGs were developed for the Health Care Financing Administration as a patient classification scheme which provides a means of relating the type of patients a hospital treats (i.e., its case mix) to the costs incurred by the hospital. While all patients are unique, groups of patients have common demographic, diagnostic and therapeutic attributes that determine their resource needs. All patient classification schemes capitalize on these commonalities and utilize the same principle of grouping patients by common characteristics.

The use of DRGs as the basic unit of payment for Medicare patients represents a recognition of the fundamental role a hospital's "sicker" patients play in determining resource usage and costs, at least on average. "The DRGs, as they are now defined, form a manageable, clinically coherent set of patient classes that relate a hospital's case mix to the resource demands and associated costs experienced by the hospital." (*Diagnosis Related Groups, Seventh Rev., Definitions Manual*, page 15.)

Each discharge in the Utah Health Discharge Database was assigned into a DRG based on the principal diagnosis, secondary diagnoses, surgical procedures, age, sex, and discharge status of the patient.

#### **❑ All-patient Refined (APR)-DRG and Patient Severity Level**

APR-DRG stands for All Patient Refined Diagnosis Related Group, software widely used in health services research. The APR-DRG software organizes about 20,000 clinical diagnoses and procedures into about 300 groups. Each APR-DRG has four severity of illness levels. In the consumer reports, we use "Patient Severity Level" to group patients into one of two groups. The severity of illness and risk of mortality subclasses have levels of 1 to 4, indicating minor, moderate, major, and extreme, respectively. In the consumer reports, patients who are assigned a minor or moderate level of severity of illness are in the Minor/Moderate group, and patients who are assigned a major or extreme level of severity of illness are in the Major/Extreme group. Patients whose care is classified in the Major/Extreme group are those who have multiple conditions, diseases, or illnesses or patients who are much sicker than other patients having the same procedure that are classified in the Minor/Moderate group. This report uses APR-DRG version 20.0 for expected deaths, because AHRQ uses this version for risk adjustment in the Inpatient

Quality Indicators. This report also uses APR-DRG version 20.0 for average charges.

Note that other Health Data Committee reports, such as the Utah Inpatient Hospital Utilization and Charges Profile --Hospital Detail report for 2004 and previous years, use APR-DRG Version 15.0.

For details on APR-DRG, see [www.3m.com/us/healthcare/his/products/coding/refined\\_drg.jhtml](http://www.3m.com/us/healthcare/his/products/coding/refined_drg.jhtml)

#### ☐ **Expected Death Percentage**

Expected death percentage is the number of deaths expected per 100 patients with a certain condition or procedure if the hospital performed the same as other hospitals in the nation with similar patients. Expected death percentage adjusts for the hospital's case mix (patients' age, gender and how ill the patients are). For example, in the health care consumer report series, a hospital's adult pneumonia expected death percentage is the number of expected patient deaths per 100 adult pneumonia patients in that hospital if it performed like similar hospitals in the Health Care Cost and Utilization Project (HCUP) State Inpatient Databases for 2003, the most recent, available national data. For some indicators, the expected death rate is per 1,000 patients with a certain condition or procedure. For more information on the AHRQ Inpatient Quality Indicators, see [www.qualityindicators.ahrq.gov/downloads/iqi/iqi\\_guide\\_v30.pdf](http://www.qualityindicators.ahrq.gov/downloads/iqi/iqi_guide_v30.pdf).

#### ☐ **Expected Use Percentage**

Expected use percentage is the number of cases expected per 100 patients that had a certain procedure if the hospital performed the same as other hospitals in the nation with similar patients. Expected use percentage adjusts for the hospital's case mix (patients' age, gender and how ill the patients are). For example, in the health care consumer report series a hospital's first-time Cesarean birth expected use percentage is the number of women expected to have a first-time Cesarean birth per 100 women giving birth in that hospital if it performed like similar hospitals in the Health Care Cost and Utilization Project (HCUP) State Inpatient Databases for 2005. For some indicators, the expected use rate is per 1,000 patients with a certain condition or procedure. For more information on the AHRQ Inpatient Quality Indicators, see [www.qualityindicators.ahrq.gov/downloads/iqi/iqi\\_guide\\_v30.pdf](http://www.qualityindicators.ahrq.gov/downloads/iqi/iqi_guide_v30.pdf).

### **Excluding Outlier Cases from Calculating Hospital Average Charges**

Some patients have exceptionally low or high lengths of stay or total facility (hospital) charges. A hospital's charges can be affected by just a few unusually long (or short) or expensive (or inexpensive) cases. These high or low values could be a result of coding or data submittal errors, particularly in length of stay, total charges, or data elements that affect APR-DRG assignments. Other reasons for exceptionally low charges could be due to death or transfer to another facility. Exceptionally high charges could be due to a catastrophic condition. Whatever the reason, these values, referred to as "outliers," distort the averages and were excluded from calculations. High charge outliers (facility) are defined in this and subsequent reports as values above 2.5 standard deviations from the state mean for each of the four levels of severity of illness for each APR-DRG. Means and standard deviations are APR-DRG specific and calculated on a statewide basis for a specific calendar year. For this report, the high outlier cases for both charge and length of stay are excluded from calculation of hospital average charges.

### **Facility Charge is Used for the Consumer's Reports**

The Utah Hospital Discharge Database contains two types of charge summary information:

- (1) Total Charges - Sum of all charges included in the billing form, including facility charges and professional fees and patient convenience items. This is different from *payment* received by the hospital or *cost* of treatment. Cost of treatment can include additional care after the patient leaves the hospital.
- (2) Facility Charges - Sum of all charges related to using a facility. Facility charge is calculated by subtracting professional fees and patient convenience item charges from total charge.

Payment received by the hospital may be less than the total charges billed for the patient's hospital stay due to contractual agreements with the insurance plans and/or charity/hardship programs available.

### **Average Charge:**

This is the calculated average for all the services for which patients in a particular severity of illness group (one of two groups) were billed as the facility charges at a particular hospital for a given condition or procedure. The average was calculated by adding the facility charges for all the services billed at that hospital for a given condition or procedure and then dividing by the total number of patients in this severity of illness group for that condition or procedure.

The method of calculating the average facility charge is identical to the method used in the HDC's standard report: Utah Hospital Utilization and Charge Profile -- Hospital Details, Table ST 1-3. In other words, both publications report average facility charges at APR-DRG and patient severity of illness level (one of four levels) without high outliers.

## **Sources of Quality and Safety Indicators**

In compliance with SB 132, the Senate Bill for the Health Care Consumer's Report, the Utah Health Data Committee adopts "nationally recognized standards" for its public reporting on quality and safety. The federal government's agency in charge of health care quality, the Agency of Healthcare Research and Quality (AHRQ) has developed a set of Quality Indicators derived from hospital discharge data. Carolyn M. Clancy, M.D., Director of the federal Agency for Healthcare Research and Quality (AHRQ) has saluted Utah's efforts. She said, "AHRQ views public reporting as one important strategy to advance the quality improvement agenda in health care," Dr. Clancy added, "Evidence shows that publicly reporting performance by specific hospitals is a key element that promotes enhanced patient care." A document entitled "Guidance for Using the AHRQ Quality Indicators for Hospital-level Public Reporting or Payment" is available at: <http://www.qualityindicators.ahrq.gov/documentation.htm>.

### **Inpatient Quality Indicators (IQIs) and Patient Safety Indicators (PSIs)**

These indicators were developed by the Agency for Healthcare Research and Quality (AHRQ) based on inpatient hospital discharge data. Although hospital discharge data do have some limitations, research has shown that IQIs and PSIs may serve as proxies for utilization, quality, or patient outcomes. AHRQ IQI and PSI definitions and analytical methods were used to calculate the utilization and quality/safety indicators in this report. For more detailed information, go to [www.qualityindicators.ahrq.gov/](http://www.qualityindicators.ahrq.gov/)

This report includes one of the AHRQ IQIs.

## **Definitions and Codes for Each Indicator**

Following pages are selected from “AHRQ Quality Indicators—Guide to Inpatient Quality Indicators: Quality of Care in Hospitals—Volume, Mortality, and Utilization. Rockville, MD: Agency for Healthcare Research and Quality, 2002. Version 3.0 (February 20, 2006).

## 5.21 Pneumonia Mortality Rate (IQI 20)

Treatment with appropriate antibiotics may reduce mortality from pneumonia, which is a leading cause of death in the United States.

Relationship to Quality	Inappropriate treatment for pneumonia may increase mortality.
Benchmark	State, regional, or peer group average.
Definition	Mortality in discharges with principal diagnosis code of pneumonia.
Numerator	Number of deaths (DISP=20) with a principal diagnosis code of pneumonia.
Denominator	All discharges with principal diagnosis code of pneumonia.  Age 18 years and older.  Exclude cases: <ul style="list-style-type: none"> <li>• missing discharge disposition (DISP=missing)</li> <li>• transferring to another short-term hospital (DISP=2)</li> <li>• MDC 14 (pregnancy, childbirth, and puerperium)</li> <li>• MDC 15 (newborns and other neonates)</li> </ul>
Type of Indicator	Provider Level, Mortality Indicator for Inpatient Conditions
Empirical Performance	Population Rate (2003): 7.75 per 100 discharges at risk
Empirical Rating	7

### Summary of Evidence

Pneumonia admissions are fairly common, and hospitals and physicians vary in admission practices. The high degree of patient heterogeneity suggests that providers may be mislabeled as poor quality without risk adjustment.

Providers with particularly high and low mortality rates should examine the case-mix of their patients for comorbidities, age, and clinical characteristics. Chart reviews may be helpful in determining whether differences truly arise from quality of care, or from patient-level differences in coding, comorbidities, or severity of disease. Providers may also wish to examine rates of outpatient care, because some patients are treated in outpatient settings.

### Limitations on Use

Pneumonia care occurs in an outpatient setting, and selection bias may be a problem for this indicator. In addition, 30-day mortality may be somewhat different than in-hospital mortality, leading to information bias. Risk adjustment for clinical factors (or at a minimum APR-DRGs) is recommended.

### Details

*Face validity: Does the indicator capture an aspect of quality that is widely regarded as important and subject to provider or public health system control?*

Pneumonia is the sixth leading cause of death in the United States.<sup>154</sup> Patient characteristics are relatively important predictors of in-hospital mortality, although the performance of specific processes of care may also lead to better patient outcomes.

*Precision: Is there a substantial amount of provider or community level variation that is not attributable to random variation?*

The high degree of heterogeneity among patients admitted for pneumonia suggests that the mortality indicator will be imprecise. However, empirical evidence shows that this indicator is precise, with a raw provider level mean of 13.8% and a standard deviation of 10.2%.<sup>155</sup>

<sup>154</sup>Hoyert DL, Kochanek KD, Murphy SL. Deaths: final data for 1997. Natl Vital Stat Rep 1999;47(19):1-104.

<sup>155</sup>Nationwide Inpatient Sample and State Inpatient Databases. Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. <http://www.ahrq.gov/data/hcup/>

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Pneumonia Mortality Rate (IQI 20)			
<b>Numerator:</b>			
Number of deaths (DISP=20) with a principal diagnosis code of pneumonia.			
<b>Denominator:</b>			
All discharges with a principal diagnosis code of pneumonia, age 18 years and older.			
ICD-9-CM pneumonia diagnosis codes:			
00322	SALMONELLA PNEUMONIA	4831	CHLAMYDIA PNEUMONIA OCT96-

Pneumonia Mortality Rate (IQI 20)			
0212	PULMONARY TULAREMIA	4838	OTH SPEC ORG PNEUMONIA
0391	PULMONARY ACTINOMYCOSIS	4841	PNEUM W CYTOMEG INCL DIS
0521	VARICELLA PNEUMONITIS	4843	PNEUMONIA IN WHOOP COUGH
0551	POSTMEASLES PNEUMONIA	4845	PNEUMONIA IN ANTHRAX
0730	ORNITHOSIS PNEUMONIA	4846	PNEUM IN ASPERGILLOSIS
1124	CANDIDIASIS OF LUNG	4847	PNEUM IN OTH SYS MYCOSES
1140	PRIMARY COCCIDIOIDOMYCOS	4848	PNEUM IN INFECT DIS NEC
1144	CHRONIC PULMONOCOCCIDIOIDOMYCOSIS	485	BRONCOPNEUMONIA ORG NOS
1145	UNSPEC PULMON COCCIDIOIDOMYCOSIS	486	PNEUMONIA, ORGANISM NOS
11505	HISTOPLASM CAPS PNEUMON	48230	STREP PNEUMONIA UNSPEC
11515	HISTOPLASM DUB PNEUMONIA	48231	GRP A STREP PNEUMONIA
11595	HISTOPLASMOSIS PNEUMONIA	48232	GRP B STREP PNEUMONIA
1304	TOXOPLASMA PNEUMONITIS	48239	OTH STREP PNEUMONIA
1363	PNEUMOCYSTOSIS	48240	STAPH PNEUMONIA UNSP OCT98-
4800	ADENOVIRAL PNEUMONIA	48241	STAPH AUREUS PNEUMON OCT98-
4801	RESP SYNCYT VIRAL PNEUM	48249	STAPH PNEUMON OTH OCT98-
4802	PARINFLUENZA VIRAL PNEUM	48281	ANAEROBIC PNEUMONIA
4803	PNEUMONIA DUE TO SARS OCT03-	48282	E COLI PNEUMONIA
4808	VIRAL PNEUMONIA NEC	48283	OTH GRAM NEG PNEUMONIA
4809	VIRAL PNEUMONIA NOS	48284	LEGIONNAIRES DX OCT97-
481	PNEUMOCOCCAL PNEUMONIA	48289	BACT PNEUMONIA NEC
4820	K. PNEUMONIAE PNEUMONIA	5070	FOOD/VOMIT PNEUMONITIS
4821	PSEUDOMONAL PNEUMONIA	5100	EMPHYEMA WITH FISTULA
4822	H.INFLUENZAE PNEUMONIA	5109	EMPHYEMA W/O FISTULA
4824	STAPHYLOCOCCAL PNEUMONIA	5110	PLEURISY W/O EFFUS OR TB
4829	BACTERIAL PNEUMONIA NOS	5130	ABSCCESS OF LUNG
4830	MYCOPLASMA PNEUMONIA		
Exclude cases:			
<ul style="list-style-type: none"> <li>missing discharge disposition (DISP=missing)</li> <li>transferring to another short-term hospital (DISP=2)</li> <li>MDC 14 (pregnancy, childbirth, and puerperium)</li> <li>MDC 15 (newborns and other neonates)</li> </ul>			

END IQI 20

## AHRQ Rates

The AHRQ Quality Indicators Software outputs several rates. The AHRQ Quality Indicators e-Newsletter, June 2005, provided guidance to users for appropriate rates to use for specific purposes.

### QI Tips: Using Different Types of QI Rates

Which rate should you use, the observed (actual), expected, risk adjusted, and/or smoothed rates?

Here are some guidelines.

If the user's primary interest is to identify cases for the health care provider's internal follow-up and quality improvement, then the **observed rate** would help to identify them. The observed rate is the raw rate generated by the QI software from the data the user provided. Areas for improvement can be identified by the magnitude of the observed rate compared to available benchmarks and/or by the number of patients impacted.

Additional breakdowns by the default patient characteristics used in stratified rates (e.g., age, gender, or payer) can further identify the target population. Target populations can also be identified by user-defined patient characteristics supplemented to the case/discharge level flags. Trend data can be used to measure change in the rate over time.

Another approach to identify areas to focus on is to compare the observed and **expected rates**. The expected rate is the rate the provider would have if it performed the same as the reference population given the provider's actual case-mix (e.g., age, gender, APR-DRG and comorbidity categories).

If the observed death rate is higher than the expected rate (i.e., the ratio of observed/expected is greater than 1.0, or observed minus expected is positive), then the implication is that the provider had more deaths than the reference population for that particular indicator. Users may want to focus on these indicators for quality improvement.

If the observed death rate is lower than the expected rate (i.e., the ratio of observed/expected is less than 1.0, or observed minus expected is negative), then the implication is that the provider had fewer deaths than the reference population. Users may want to focus on these indicators for identifying best practices.

If the observed use rate is higher than the expected rate, then the implication is that the provider had more patients with the specified procedure than the reference population for that particular indicator. If the observed use rate is lower than the expected rate, then the implication is that the provider had fewer patients with the specified procedure than the reference population for that particular indicator.

Users can also compare the expected rate to the **population rate** reported in the detailed evidence section of the IQI, PQI, or PSI Guide to determine how their case-mix compares to the reference population. If the population rate is higher than the expected rate, then the provider's case-mix is less severe than the reference population. If the population rate is lower than the expected rate, then the provider's case-mix is more severe than the reference population.

AHRQ uses this difference between the population rate and the expected rate to "adjust" the observed rate to account for the difference between the case-mix of the reference population and the provider's case-mix. This is the provider's **risk-adjusted rate**.

If the provider has a less severe case-mix, then the adjustment is positive (population rate > expected rate) and the risk-adjusted rate is higher than the observed rate. If the provider has a more severe case-mix, then the adjustment is negative (population rate < expected rate) and the risk-adjusted rate is lower than the observed rate. The risk-adjusted rate is the rate the provider would have if it had the same case-mix as the reference population given the provider's actual performance.

Finally, users can compare the risk-adjusted rate to the **smoothed** or “reliability-adjusted” rate to determine whether this difference between the risk-adjusted rate and reference population rate is likely to remain in the next measurement period. Smoothed rates are weighted averages of the population rate and the risk-adjusted rate, where the weight reflects the reliability of the provider's risk-adjusted rate.

A ratio of (smoothed rate - population rate) / (risk-adjusted rate - population rate) greater than 0.80 suggests that the difference is likely to persist (whether the difference is positive or negative). A ratio of less than 0.80 suggests that the difference may be due in part to random differences in patient characteristics (patient characteristics that are not observed and controlled for in the risk-adjustment model). In general, users may want to focus on areas where the differences are more likely to persist.

From <http://qualityindicators.ahrq.gov/newsletter/2005-June-AHRQ-QI-Newsletter.htm#Headline3> (Accessed on January 18, 2006).

## **Statistical Tests and Rating System**

### **Star Rating**

The star rating system in the report is based on a test of statistical significance. This test shows whether the difference between a hospital's observed (actual) rate and the expected rate is real or just due to chance. For each indicator, the upper and lower 95% confidence intervals were calculated for each hospital's rate. The 95% confidence interval is the interval that one can be 95% certain contains the “true” hospital average. The 95% confidence interval for each hospital was then compared to the expected rate. If the lower limit of 95% confidence interval of a hospital rate is higher than the expected rate, that means the hospital rate is significantly higher than the expected rate. It is rated as one star, “ \* ”. If the higher limit of 95% confidence interval of a hospital rate is lower than the expected rate that means the hospital rate is significantly lower than the expected rate. It is rated as three stars, “ \*\*\* ”. If a hospital's 95% confidence intervals overlap with the expected rate, the hospital rate is not significantly different from the expected rate, and is rated as two stars, “ \*\* ”.

Keep in mind that many factors affect the hospital's rates. For example, in this health care consumer report series a hospital that cares for a lot of high-risk patients may have a higher rate of a quality or safety indicator, but that does not mean that the hospital delivers poor quality care.

### **95% Confidence Interval**

Most methods for calculation of confidence intervals assume a normal distribution among the values for which the confidence intervals are calculated. However, these formulas do not work well on small numbers. The formula for exact confidence intervals does not assume a normal distribution. Instead, confidence intervals of the actual (observed) rate are calculated using the method of exact confidence intervals for the cumulative binomial distribution (Holubkov, 1998). This method is more appropriate for rates based on small numbers than other methods and is used in this report's rating system.

The statistical formulas to calculate standard errors and 95% confidence intervals are as follows:

$$[[Pi].sub.L]=x/(x+[n-x+1][F.sub..025,2n-2x+2,2x])$$

$$[[Pi].sub.U]=(x+1)/(x+1+[n-x][[F.sub..025,2x+2,2n-2x]].sup.-1))$$

Formulas used in the Excel worksheet to calculate the values for indicators based on number of patients per 100 are:

$$95\% \text{ CI LowerLimit} = (x/(x+(n-x+1)*\text{finv}(0.025, (2*(n-x)+2), 2*x)))*100$$

$$95\% \text{ CI UpperLimit} = ((x+1)/(x+1+(n-x)/\text{finv}(0.025, 2*x+2, 2*(n-x))))*100$$

Where:

[Pi].sub.L = Value of 95% Confidence Interval Lower Limit

[Pi].sub.U = Value of 95% Confidence Interval Lower Limit

x = numerator/number of events

n = denominator/number of risk population

F = F distribution

F.sub..025 = Selected critical value for 95% Confidence Interval

For indicators based on number of patients per 1000, the formulas are the same except that the last term is 1000 instead of 100.

The health care consumer reports use the values that these formulas produce. An exception is cases in which the lower limit is a negative value. These negative values are converted to zero.

Reference: Holubkov, R. 1998 (August). "Analysis, assessment, and presentation of risk-adjusted statewide obstetrical care data: the StORQS II study in Washington State-Statewide Obstetrics Review and Quality System" published in Health Service Research.

Health care consumer reports may use some of the following additional methods:

### **I. AHRQ Method for Calculating Standard Errors for the Actual [Observed] Rates**

1) The root mean squared error (RMSE) for each QI for "Hospital J" is:

$$RMSE = \text{sqrt}(\text{RATE}_{ij}*(1-\text{RATE}_{ij}))$$

where RATE<sub>ij</sub> is the observed rate for "QI #i" and "Hospital J"

- 2) The standard error on the observed rate for “Hospital J” is:

$$SE = RMSE / \sqrt{N_{ij}}$$

where  $N_{ij}$  is the denominator for “QI #i” and “Hospital J”

- 4) The 95% confidence interval on the observed rate for “Hospital J” for each QI is:

$$\text{Lower confidence interval} = \text{“Hospital J” observed rate} - (1.96 * SE)$$

$$\text{Upper confidence interval} = \text{“Hospital J” observed rate} + (1.96 * SE)$$

- 5) For example, if the rate for “Hospital J” for IQI #12 is Rate=0.10 and the denominator is N=20,000, then the lower bound 95% CI is:

$$\begin{aligned} 0.10 - 1.96 * \sqrt{(0.10 * (1-0.10)) / 20000} &= \\ 0.10 - 1.96 * 0.021213 &= \\ 0.10 - 0.041578 & \end{aligned}$$

and the upper bound 95% CI is:

$$\begin{aligned} 0.10 + 1.96 * \sqrt{(0.10 * (1-0.10)) / 20000} &= \\ 0.10 + 1.96 * 0.021213 &= \\ 0.10 + 0.041578 & \end{aligned}$$

## II. Calculating Standard Errors for the IQI Risk-adjusted Rates

### Risk adjusted rates

- 1) Open the file IQI\_V21\_R4\_RMSE.xls in the AHRQ Quality Indicator Software Package
- 2) The column labeled “RMSE” is the root mean squared error (RMSE) for each IQI based on the risk-adjustment model.
- 3) The standard error on the risk-adjusted rate for “Hospital J” is:

$$SE = \sqrt{MSE / N_{ij}} = RMSE / \sqrt{N_{ij}}$$

where  $N_{ij}$  is the denominator for “IQI #i” and “Hospital J”

- 4) The 95% confidence interval on the risk-adjusted rate for “Hospital J” for each IQI is:

$$\text{Lower confidence interval} = \text{“Hospital J” risk-adjusted rate} - (1.96 * SE)$$

$$\text{Upper confidence interval} = \text{“Hospital J” risk-adjusted rate} + (1.96 * SE)$$

- 5) For example, if the denominator for “Hospital J” for IQI #12 is N=20,000, then RMSE=0.171757 and the lower bound 95% CI is:

$$\begin{aligned} \text{rate} - 1.96 * (0.171757 / \sqrt{20000}) &= \\ \text{rate} - 1.96 * 0.012145 &= \\ \text{rate} - 0.023804 & \end{aligned}$$

and the upper bound 95% CI is:

$$\begin{aligned} &\text{rate} + 1.96 * (0.171757 / \sqrt{20000}) = \\ &\text{rate} + 1.96 * 0.012145 = \\ &\text{rate} + 0.023804 \end{aligned}$$

## **Limitations**

This report shows total billed facility charges. Billed charges are to be used as only one indicator of hospital performance. All patients, or insurance plans, do not pay the same amount for similar treatments, supplies, services, and procedures, even though they may be billed the same amount. Hospitals offer a variety of contracts, many with discount arrangements based on volume. Because of this, the data reflect pre-contractual prices for hospitalization and not the actual payment between providers and payers.

This report can be used to compare broad measures of utilization for all hospitals, but more detailed data are needed to look at specific performance comparisons between hospitals. This information serves as an important first step toward consumers' taking a more active role in health care decision-making.

The price of hospital services, while important, is not the only consideration in making inpatient hospital decisions. Other factors that may influence hospital services, including the type of condition treated, the physicians who practice at the hospital and the insurance company's managed care policies. The subscriber should be familiar with his or her health plan long before hospital care is needed. (For additional information on managed care performance please contact the Office of Health Care Statistics at (801) 538-7048.)

## **Kinds of Pneumonia Included in This Report**

This report includes some but not all kinds of pneumonia among adult hospital inpatients (age 18 years and older). Though pneumonia can be a serious illness for children, the causes, course of disease and outcomes are different for adults.

### **Average Hospital Charge**

The average hospital charge in this report is for patients in the All Patient Refined Diagnosis Related Group 139 (APR-DRG 139) Other Pneumonia. "Other Pneumonia" includes some of the more common kinds of bacterial, viral and mycoplasma pneumonia as well as influenza with pneumonia. It does not include respiratory syncytial viral (RSV) pneumonia, which is more common among children than adults, or many of the rarer kinds of bacterial, viral and fungal pneumonia such as those associated with tuberculosis and cystic fibrosis. A complete list of kinds of pneumonia included in APR-DRG 139 follows on the next page.

## APR-DRG 139 Other Pneumonia ICD-9-CM Codes

ICD-9-CM Code	Description
480	Pneumonia due to adenovirus
480.2	Pneumonia due to parainfluenza virus
480.8	Pneumonia due to other virus not elsewhere classified
480.9	Unspecified viral pneumonia
481	Pneumococcal pneumonia (streptococcus pneumoniae pneumonia)
482.30	Pneumonia due to unspecified Streptococcus
482.31	Pneumonia streptococcus a
482.32	Pneumonia streptococcus b
482.39	Pneumonia other streptococcus
482.9	Bacterial pneumonia not otherwise specified
483.0	Pneumonia due to mycoplasma pneumoniae
483.1	Pneumonia due to chlamydia
483.8	Pneumonia due to other specified organism
485	Bronchopneumonia organism not specified
486	Pneumonia, organism not specified
487.0	Influenza with pneumonia

### In-hospital Deaths Among Adult Pneumonia Patients

The indicator for in-hospital deaths among adult pneumonia patients is more inclusive than the indicator for average hospital charges. It includes some but not all kinds of pneumonia from:

APR-DRG 137 Major Respiratory Infections and Inflammations

APR-DRG 138 Bronchiolitis and Respiratory Syncytial Viral (RSV) Pneumonia

APR-DRG 139 Other Pneumonia

A complete list of kinds of pneumonia included in this indicator is on page 7 of this document. A list that shows the ICD-9-CM codes for these kinds of pneumonia by APR-DRG follows on the next page.

## AHRQ In-hospital Pneumonia Deaths (IQI 20) ICD-9-CM Diagnosis Codes by APR-DRG (v. 20.0)

AHRQ IQI 20	Pneumonia In-hospital Deaths	APR- DRG 137	APR- DRG 138	APR- DRG 139
003.22	Salmonella pneumonia	X		
021.2	Pulmonary tularemia	X		
039.1	Pulmonary actinomycosis	X		
052.1	Varicella pneumonitis	X		
055.1	Postmeasles pneumonia	X		
112.4	Candidiasis of lung	X		
114.0	Primary coccidioidomycosis	X		
114.4	Chronic pulmonary coccidioidomycosis	X		
114.5	Unspecified pulmonary coccidioidomycosis	X		
115.05	Histoplasma capsulatum pneumonia	X		
115.15	Histoplasma duboisii pneumonia	X		
115.95	Unspecified Histoplasmosis pneumonia	X		
130.4	Pneumonitis due to toxoplasmosis	X		
136.3	Pneumocystosis	X		
480.0	Pneumonia due to adenovirus			X
480.1	Pneumonia due to respiratory syncytial virus		X	
480.2	Pneumonia due to parainfluenza virus			X
480.3	Pneumonia due to SARS-associated coronavirus			
480.8	Pneumonia due to other virus not elsewhere classified			X
480.9	Unspecified viral pneumonia			X
481	Pneumococcal pneumonia (streptococcus pneumoniae pneumonia)			X
482.0	Pneumonia due to Klebsiella pneumoniae	X		
482.1	Pneumonia due to Pseudomonas	X		
482.2	Pneumonia due to Hemophilus influenzae	X		
482.30	Pneumonia due to unspecified Streptococcus			X
482.31	Pneumonia due to Streptococcus, group A			X
482.32	Pneumonia due to Streptococcus, group B			X
482.39	Pneumonia due to other Streptococcus			X
482.4	Pneumonia due to Staphylococcus			X
482.40	Pneumonia due to Staphylococcus, unspecified			X



## AHRQ In-hospital Pneumonia Deaths (IQI 20) ICD-9-CM Diagnosis Codes by APR-DRG (v. 20.0) and DRG (2006)

AHRQ IQI 20	Pneumonia In-hospital Deaths	APR- DRG 137	APR- DRG 138	APR- DRG 139
482.4	Pneumonia due to Staphylococcus	X		
482.40	Pneumonia due to Staphylococcus, unspecified	X		
482.41	Pneumonia due to Staphylococcus aureus			X
482.41	Pneumonia due to Staphylococcus aureus	X		
482.49	Other Staphylococcus pneumonia			X
482.49	Pneumonia due to other Staphylococcus pneumonia	X		
482.81	Pneumonia due to anaerobes	X		
482.82	Pneumonia due to escherichia coli (E. coli)	X		
482.83	Pneumonia due to other gram-negative bacteria	X		
482.84	Legionnaires' disease	X		
482.89	Pneumonia due to other specified bacteria	X		
482.9	Unspecified bacterial pneumonia			X
483.0	Pneumonia due to Mycoplasma pneumoniae			X
483.1	Pneumonia due to Chlamydia			X
483.8	Pneumonia due to other specified organism			X
484.1	Pneumonia in cytomegalic inclusion disease	X		
484.3	Pneumonia in whooping cough	X		
484.5	Pneumonia in anthrax	X		
484.6	Pneumonia in aspergillosis	X		
484.7	Pneumonia in other systemic mycoses	X		
484.8	Pneumonia in other infectious diseases classified elsewhere	X		
485	Bronchopneumonia organism not otherwise specified			X
486	Pneumonia, organism not otherwise specified			X
507.0	Food/vomit pneumonitis	X		
510.0	Empyema with fistula	X		
510.9	Empyema without mention of fistula	X		
511.0	Pleurisy without mention of effusion or tuberculosis	X		
513.0	Abscess of lung	X		

Note: The above APR-DRGs include additional ICD-9-CM codes, not listed here.

The above table includes only the ICD-9-CM in the AHRQ indicator for in-hospital deaths among adult pneumonia patients (IQI 20).